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Cryogenic system design for a hydrogen sorption cooler *

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For several future space applications, long life vibration free coolers are needed to cover the temperature range from 60K to about 4K. We describe the development of a novel cryogenic system capable of reaching 18K in coupled reservoirs that provide distributed cooling with small temperature fluctuations. The cryogenic gas circulating through the system is hydrogen. We use single-stage Joule-Thomson expansion from a pre-cooling temperature between 60K -50K, with a porous stainless-steel flow restrictor, to liquefy the gas and three independent reservoirs to capture this liquid. The cooler will use a metal hydride compressor to provide a continuous hydrogen gas desorption into the high-pressure side at 50 bar, and to provide absorption at a constant outlet pressure of 0.5 bar. Current tests for the cryogenic line characterization use bottle gas and vacuum station to simulate these conditions. The cryogenic line, designed for space applications, has two independent heat loads with independent requirements in temperature (20K/18K), stability (temperature fluctuations as small as possible) and cooling power (0.95W/0.175W). This sorption cooler is part of a complex cryogenic system, where three different coolers are involved with the principal goal to measure temperature fluctuations of a few nK. In order to reduce as much as possible parasitics, the temperature stability for sorption cooler must be of order of mK. Current measured temperature fluctuations are about 20mK without any electronics temperature controller. We describe also the tests performed to assess gravity influence during ground tests.

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